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## ON BÖHM-BAWERK'S THEORY OF INTEREST-RATE

### 1. INTRODUCTION

In Böhm-Bawerk's theory of interest-rate lies concealed a momentous assumption which has, so far as I can see, not hitherto been pointed out by anybody—an assumption which has a necessary connection with his negation of "Macht-theorie." The aim of the present article is to point out this assumption and this connection. Before developing my main argument, I shall make citations from his theory of interest-rate. This part of the article, as well as the part of chapter 3 in which citations are made from Böhm-Bawerk's theory regarding the method of calculating the number of employees, may well be skipped by specialists, as it will be, for them, familiar ground.

### 2. BÖHM-BAWERK'S THEORY OF INTEREST-RATE

Böhm-Bawerk's theory is developed along the following lines:

"Let it be assumed that the demand and supply in regard to the existing goods meet in the sole market, that . . . . productive power ( $= \frac{\text{total price of means of consumption}}{\text{number of employees}}$ ) is equal in all sections of production and that the increase of productive power resulting from an extension of the period of production (attainment of a higher level by the technical composition of capital—Shibata) is also equal, that is, surplus profit stages are equal. Next, let it be assumed that the amount of property to be invested is 15,000,000,000 gulden, and the number of labourers 10,000,000. Let it further be assumed that the annual product per labourer ( $= \frac{\text{total price of means of consumption}}{\text{number of employees}}$ ) . . . (as is shown in II of the following table) increases in the same way in all sections of production from 350 gulden (where the period of production is one year) to 700 gulden (where the period of production is ten years), according to the periods of production to

be adopted.<sup>1)</sup> "Now, (assuming that the capital of 15,000,000,000 gulden has been divided among 1,500,000 enterprises in equal proportions, so that each enterprise has a capital of 10,000 gulden), let wages be 300 gulden, and then a capitalist possessed of 10,000 gulden can either employ 66.6 labourers on a "one-year production" scheme, or employ 33.3 labourers on a "two-years production" scheme, or employ 22.2 labourers on a "three-years production" scheme. He is free to choose whichever form of production he pleases. He will, of course, choose the form most profitable to him. Table No. 1 shows the form which is most profitable to him.

Period of production I	Annual product per labourer II	Table No. 1 (Wages=300 fl.)		
		Annual profit per labourer III	Number of employees IV	Annual profit per 10,000 fl. V
1 year	350 fl.	50 fl.	66.66	3,333.3 fl.
2 years	450 "	150 "	33.33	5,000.0 "
3 "	530 "	230 "	22.22	5,111.1 "
4 "	580 "	280 "	16.66	4,666.6 "
5 "	620 "	320 "	13.33	4,266.6 "
6 "	650 "	350 "	11.11	3,888.5 "
7 "	670 "	370 "	9.25	3,522.4 "
8 "	685 "	385 "	8.33	3,208.2 "
9 "	695 "	395 "	7.40	2,925.0 "
10 "	700 "	400 "	6.66	2,666.6 "

Table No. 2 (Wages=600 fl.)			Table No. 3 (Wages=500 fl.)		
Annual profit per labourer VI	Number of employees VII	Annual profit per 10,000 fl. VIII	Annual profit per labourer IX	Number of employees X	Annual profit per 10,000 fl. XI
-250 fl.	33.33	loss	-150 fl.	40.00	loss
-150 "	16.66	loss	- 50 "	20.00	loss
- 70 "	11.11	loss	30 "	13.33	400.00 fl.
- 20 "	8.33	loss	80 "	10.00	800.00 "
20 "	6.66	133.33 fl.	120 "	8.00	960.00 "
50 "	5.55	277.77 "	150 "	6.66	1,000.00 "
70 "	4.76	333.33 "	170 "	5.71	970.70 "
85 "	4.16	354.16 "	185 "	5.00	925.00 "
95 "	3.70	351.50 "	195 "	4.44	866.66 "
100 "	3.33	333.33 "	200 "	4.00	800.00 "

1) Böhm-Bawerk; Kapital und Kapitalzins, II. Abt., 1. Bd., 4. Aufl. 1921, S. 444-445.

"Table No. 1 shows the number of labourers that can be employed and the amount of the annual profit that can be realised with a capital of 10,000 gulden when the index number of productive power ( $= \frac{\text{total price of means of consumption}}{\text{number of employees}}$ ) for each period of production (when wages are 300 gulden) is such as is assumed above. It indicates that when the various factors are such as are assumed above, the choice of the three-years period of production is most profitable to an enterprise. . . . In such circumstances, all entrepreneurs will, of course, try to choose this most profitable period of production, but . . . as the number of labourers employed under the three-years production programme launched by an entrepreneur with a capital of 10,000 gulden is 22.2 . . . , 33,330,000 labourers will have to be employed in order to operate the total capital of 15,000,000 gulden existing in the national economy. As a matter of fact, however, the number of labourers available is only 10,000,000 and 4,500,000,000 gulden would suffice to employ these 10,000,000 labourers. Then, the rest of the capital amounting to 10,500,000,000 gulden would have to remain idle. (But) Entrepreneurs could not, of course, afford to leave their capital idle, nor would they like to do so. (Accordingly) They would vie with one another in an attempt to induce labourers into their respective enterprises by paying them higher wages than their rivals. This competition necessarily forces up wages. . . . Let us, then, suppose that wages . . . rise to 600 gulden. According to Table No. 2, when wages rule at 600 gulden, an eight-years period of production is most profitable. But . . . if the form of eight-years production is chosen . . . a capital of 10,000 gulden enables the entrepreneur to employ 4.16 labourers only. Consequently, even with the total national capital of 15,000,000,000 gulden, the number of labourers that can be employed will be no larger than 6,250,000. The other 3,750,000 labourers will then be condemned to unemployment. Thus, the idea of 600 gulden wages is untenable. Labourers out of work are naturally eager to offer their labour power, and this will cause wages to fall below 600 gulden. Then . . . at what level will wages be determined? The answer to this question is given in Table No. 3, which shows that they settle at 500 gulden. With wages at 500 gulden, the six-years period of production is the most profitable. In this case, 6.66 labourers can be employed with a capital of 10,000 gulden. With the total national capital of 15,000,000,000 gulden, therefore, exactly 10,000,000 labourers can be employed. . . . In this way, the point is reached at which wages can properly be determined.<sup>1)</sup>

1) Böhm-Bawerk; a.a. O. S. 450-453.

### 3. SOME PREPARING REMARKS

One point worthy of special note about the above theorising by Böhm-Bawerk is the assertion that, whereas, as is shown in the various tables given, the increase of wages—to 600 gulden, for instance—reduces the incomes of the working class to 3,750,000,000 gulden, their incomes will be 4,950,000,000 gulden, if free competition prevails in the labour market, which means, that a combination of labourers for higher wages has the opposite effect of injuring their own interests.

Before proceeding to a critical analysis of Böhm-Bawerk's theory, let me consider his method of working out the number of employees. In his calculation, he assumes that supplementary investments take place successively at infinitesimal intervals, but the feasibility of this assumption is doubtful.

He says:

"Assuming the period of production to be one year and investment made only once, . . . the means of sustenance sufficient to cover the entire annual consumption of the labourers must exist—in a state fit for immediate consumption too—at the beginning of the production period. (Accordingly) if the means of sustenance be indicated by  $S$  and the annual consumption by  $J$ , . . .  $S=J$ . If the period of production is two years and supplementary investments are to be made each year, there must exist in a finished state, at the beginning of the production period the amount of goods required for consumption in the first year and that required for consumption in the second year must exist in a half-finished state. Then, the labourers consume each year the finished goods ready for consumption, while converting the half-finished goods into finished goods for consumption in the following year—on which they are to subsist during that year—, and also set about the production of the amount required for consumption in the third year so as to put such goods into a half-finished state. If, in this case, the half-finished goods for annual consumption are of half the amount of the finished goods for annual consumption,  $S=1\frac{1}{2}J$ . In the same way, if the period of production is three years and supplementary investments are to be made each year, there must be one complete set of finished goods for annual consumption, goods two-thirds finished for annual consumption and goods one-thirds finished for annual consumption. In such a case, the labourers consume each year the finished goods, turn goods two-thirds finished into finished goods for consumption in the next year, make goods one-thirds finished into goods,

two-thirds finished and proceed to the production of the goods for consumption in the fourth year so that they may be left at the end of the year in a state of goods that are one-thirds finished. . . . Accordingly, in this case,  $S = 1J + \frac{2}{3}J + \frac{1}{3}J = 2J$ . (This rule applies correspondingly to all other cases). . . . And, if these figures are closely examined, the law operating at the bottom becomes manifest. That is to say, no matter what is the period of production, the means of sustenance required for it must necessarily be of the size to meet the demand of the period representing one half of the period of production plus a half year. Consequently, if the period of production is  $n$  years and supplementary investments are made each year successively,  $S = (1+n) \cdot \frac{1}{2}J$ . (Accordingly, if  $n$  is infinity,  $S = \frac{n}{2}J$ .) (So far, the subject has been studied by varying the period of production, and now I shall consider cases where the period of production is fixed at one year and the intervals between supplementary investments vary.) Supposing that the period of production is one year and supplementary investments are made every six months, we need the finished goods for the first half year . . . and the half-finished goods for the second half year . . . . Consequently,  $S = \frac{1}{2}J + \frac{1}{2} \times \frac{1}{2}J$ . . . .  $\frac{3}{4}J$ . (Accordingly, if one year is to be divided into  $n'$  number of periods,  $S = \frac{1}{n'}(1+n') \cdot \frac{1}{2}J = \left(\frac{1}{n'} + 1\right) \cdot \frac{1}{2}J$ . If, therefore,  $n'$  embodies an infinity,  $S = \left(\frac{1}{\infty} + 1 \cdot \frac{1}{2}\right)J = \frac{1}{2}J$ .)<sup>1)</sup>

If, for instance, the period of production is one year and supplementary investments are made every six months successively,  $s = \frac{1}{2} \left(1 + \frac{1}{2}\right)J = \frac{3}{4}J$ . As the wage fund is only  $\frac{1}{2}J$ , the wage fund contained in  $s$  is only  $\frac{1}{2}J \div \frac{3}{4}J = \frac{2}{3}$ . Again, if the period of production is one year and supplementary investments are made every four months,  $s = \frac{1}{3} \left(1 + \frac{2}{3} + \frac{1}{3}\right)J = \frac{2}{3}J$ . As the wage fund is here only  $\frac{1}{3}J$ , the wage fund contained in  $s$  is only  $\frac{1}{3}J \div \frac{2}{3}J = \frac{1}{2}$ . As the intervals of supplementary investments are shortened, the wage fund is reduced. Now, supposing the period of production to be one year and supplementary investments

1) Böhm-Bawerk: Kapital und Kapitalzins, II Abt., II Bd., S. 347-348.

made every  $\frac{1}{n'}$  years,  $s = \frac{1}{n'}(1 + n')\frac{1}{2}J = (\frac{1}{n'} + 1)\frac{1}{2}J$ . Here, the wage fund is only  $\frac{1}{n'}J$ , and so the wage fund contained in  $s$  is only  $\frac{1}{n'}J : \frac{1}{n'}(1 + n')\frac{1}{2}J = \frac{2}{1 + n'}$ . If, therefore, the intervals of supplementary investments become infinitely small, the wage fund contained in  $s$  is reduced to  $\frac{2}{1 + \infty}$ , which means zero.

(This notwithstanding, the number of labourers employed on the fixed allowance of means of subsistence, when the intervals between supplementary investments are infinitely small, is shown to be twice as large as it is, when supplementary investments are made at intervals of twelve month. This is due to the fact that the shortening of the intervals between supplementary investments means the reduction of the rotation period of capital.)

Accordingly, it is not proper to assume such a contingency. Let me discard such an assumption, therefore, and suppose that supplementary investments are made at intervals of twelve months. Then, as is clear from the formulae already given, the circumstances ruling where wages are 300 gulden will be such as are given in the following Revised Table No. 1:—

Period of production	Annual product per labourer	Revised Table No. 1 (Wages=300 fl.)		
		Annual profit per labourer	Number of employees	Annual profit per 10,000 fl.
1 year	350 fl.	50 fl.	33.33	1,666.67 fl.
2 years	450 "	150 "	22.22	3,333.33 "
3 "	530 "	230 "	16.67	3,833.33 "
4 "	580 "	280 "	13.33	3,733.33 "
5 "	620 "	320 "	11.11	3,555.56 "
6 "	650 "	350 "	9.52	3,333.33 "
7 "	670 "	370 "	8.33	3,083.33 "
8 "	685 "	385 "	7.41	2,851.85 "
9 "	695 "	395 "	6.66	2,633.33 "
10 "	700 "	400 "	6.06	2,424.24 "



## 4. MAIN ARGUMENT

Having now reviewed Böhm-Bawerk's method of working out the number of employees, I shall proceed to my main argument on the subject.

According to the various Böhm-Bawerk's tables, it necessarily follows that the higher the wages, the smaller the incomes of the working class as a whole become. Will, then, the attempt to raise wages over and above where they are, as determined by free competition, invariably cause the reduction of the total income of the working class, or is it possible that there is something wrong about Böhm-Bawerk's tables?

In order to examine these points, we must first know the nature of the technical composition of capital which is virtually assumed in the Revised Table No. 1. This can be ascertained in this way:—Multiply the number of employees given in the Revised Table No. 1 by wages, then the total amount of wages, or the amount of variable capital, will be found. Now, as the total amount of capital is already given by the assumption, the amount of constant capital can be found, once the amount of variable capital is ascertained. Accordingly, if the price of the means of production (= capital goods) is given, the requisite amount of the means of production can be found by dividing the amount of constant capital by this price. If the above method of calculation is applied by assuming wages to be 300 gulden and the price of the means of production 100 gulden (this assumption is designed merely for facilitating calculation and has nothing whatever to do with the essential nature of the matter), we obtain the results given in the following table:—

Period of production	Number of employees	Variable capital	Constant capital	Means of production	Technical composition of capital
1.00	33.33	10,000.00	0.00	0.00	0.00
2.00	22.22	6,666.67	3,333.33	33.33	1.50
3.00	16.67	5,000.00	5,000.00	50.00	3.00

4.00	13.33	4,000.00	6,000.00	60.00	4.50
5.00	11.11	3,333.33	6,666.67	66.67	6.00
6.00	9.52	2,857.14	7,142.86	71.43	7.50
7.00	8.33	2,500.00	7,500.00	75.00	9.00
8.00	7.41	2,222.22	7,777.78	77.78	10.50
9.00	6.67	2,000.00	8,000.00	80.00	12.00
10.00	6.06	1,818.18	8,181.82	81.82	13.50

The above table shows the technical composition of capital which is virtually assumed in the Revised Table No. 1.

*Let it now be assumed that the technical composition of capital is identical in all sections of production. Then, changes in wages cannot alter the relative prices of the various kinds of products, in so far as the same method of production concerns. Accordingly, in so far as the same method of production concerns, changes in wages inevitably cause changes in the price composition of capital.* For instance, in the case where the technical composition of capital is 1.5 : 1, the price composition of capital ought to be  $(1.5 \times 100 \text{ fl.}) : (1 \times 300 \text{ fl.})$  when wages are 300 gulden, while it ought to be  $(1.5 \times 100 \text{ fl.}) : (1 \times 600 \text{ fl.})$  when wages rise to 600 gulden. If we first seek by this method the price composition of capital in cases where wages have advanced, in regard to the various technical compositions of capital already mentioned, and then work out the amounts of variable capital where the total amount of capital is 10,000 gulden and next work out number of employees by dividing the amount of variable capital by wages, and lastly calculate on that basis the annual profits per capital of 10,000 gulden, we obtain the results shown in the following table:—

Technical composition of capital	Annual product per labourer	Revised Table No. 2 (Wages=600 fl.)			Revised Table No. 3 (Wages=500 fl.)		
		Annual profit per labourer	Number of employees	Annual profit per 10,000 fl.	Annual profit per labourer	Number of employees	Annual profit per 10,000 fl.
0.0	350 fl.	-250 fl.	16.67	loss	-150 fl.	20.00	loss
1.5	450 "	-150 "	13.33	loss	- 50 "	15.38	loss
3.0	530 "	- 70 "	11.11	loss	30 "	12.50	375.00 fl.
4.5	580 "	- 20 "	9.52	loss	80 "	10.53	842.11 "

6.0	620 "	20 "	8.33	166.67 "	120 "	9.09	1,090.91 "
7.5	650 "	50 "	7.41	370.36 "	150 "	8.00	1,200.00 "
9.0	670 "	70 "	6.67	466.67 "	170 "	7.14	1,214.29 "
10.5	685 "	85 "	6.06	515.15 "	185 "	6.45	1,193.55 "
12.0	695 "	95 "	5.56	527.78 "	195 "	5.88	1,147.06 "
13.5	700 "	100 "	5.13	512.82 "	200 "	5.41	1,081.08 "

In Revised Tables Nos. 2 and 3, there exists a special circumstance which is absent from Revised Table No. 1. This special circumstance is of peculiar importance here. In Revised Table No. 1, the number of employees, in cases where the period of production is two years or over, can be worked out by dividing twice the number to be employed where the period of production is one year by  $(n+1)$ , according to the formula:  $s = (n+1) \frac{1}{2} J$ , which is applicable to cases where investments are supplemented at intervals of twelve months. Where the period of production is two years or over, in the case of Revised Table Nos. 2 and 3, however, the division of twice the number to be employed where the period of production is one year by  $(n+1)$  will produce figure which are different from the number of employees given in the above tables, in so far as it is assumed "that in this case also, the same method of production means the same period of production as is given in Revised Table No. 1." This is what I call a special circumstance. This circumstance is due to the fact that, if wages change, the same technical composition of capital comes to signify different price composition of capital, and consequently, different periods of production.

What period of production it has come to signify can be found by the following process of calculation. Supposing that investments are supplemented each year, a relationship of  $s = (n+1) \frac{1}{2} J$  arises, as already explained. Therefore, if  $x$  is to represent the price composition of capital,  $x = \frac{s-J}{J} = \frac{(n+1) \frac{1}{2} J - J}{J} = -\frac{1}{2} (n-1)$ . When the price composition of capital,

x, is found, n can be worked out from it. The price composition of capital is, in fact, found in the formulation of the various revised tables already given. If the periods of production are worked out by it, the methods of production, which signify the periods of production of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 years respectively, when wages rule at 300 gulden, will signify the periods of production of 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, and 5.5 years respectively, when wages are 600 gulden, and of 1, 1.6, 2, 2.8, 3.4, 4, 4.6, 5.2, 5.8 and 6.4 years respectively, where wages stand at 500 gulden.

*In Böhm-Bawerk's tables, however, the same method of production always means the same price composition of capital (and accordingly the same period of production), regardless of change in wages. The reason why such a result becomes inevitable lies just in his concept of the "period of production". Two assumptions, both of which are important in their relation to the matter in hand, enter into the composition of his concept of the "period of production."*

In the first place, in his conception of the "period of production," each of means of production is assumed to be useful only in one direction and in successive order. He takes the view, for instance, that *a* pieces of the means of production, *A*, is produced by labour power (and land power—mention of which will hereunder be omitted) only, and is employed for the production of the means of production, *B*, exclusively; that *b* pieces of the means of production, *B*, is manufactured by the *a* pieces of the means of production, *A*, and labour power only, and is employed for the production of the means of consumption, *C*, and that the means of consumption, *C*, is produced by the *b* pieces of the means of production, *B*, and labour power only. He thus ignores the fact that the means of production, *A*, itself as well as the means of production, *B*, is necessary for the production of the means of production, *A*. He also leaves out of consideration the fact that (*a*+4*a*) pieces of the means of production, *A*, is necessary (as fixed capital) for

the production of the means of production,  $B$ , and that  $(b + 4b)$  pieces of the means of production,  $B$ , is necessary (as fixed capital) for the production of the means of consumption,  $C$ .<sup>1)</sup> Thus, in his view, *the technical composition of capital of the means of production is of necessity lower than that of the means of consumption*. He naturally concludes that a rise in wages necessarily forces the price of the means of production higher than that of the means of consumption. Accordingly, it is maintained that a rise in wages under the same technical composition of capital does not affect the price composition of capital, because while it is bound to expand variable capital, on the one hand, constant capital is also expanded, on the other, by the advance of the price of the means of production.

If the premise is confined to the above-mentioned assumption, it is quite conceivable that a rise in wages will force price of the means of production higher than that of the means of consumption and will expand constant capital to counteract the expansion of variable capital, which results from higher wages, but it will not necessarily follow that the expansion in both cases will be exactly of the same dimensions so that the price composition of capital will remain unchanged. It is Böhm-Bawerk's second assumption which accounts for this necessary conclusion. This assumption is that *all means of production are themselves invariably produced within the section producing the means of consumption*.

That there exists such an assumption can be proved in the following way: Let it now be assumed (a) that each of the means of production and of the means of consumption is of one kind only, (b) that each product is produced within the same duration of time (as, for example, within a year), (c) that labour power only is needed for the

1) Böhm-Bawerk's theory has been criticised by many scholars from this angle, as, for instance, by Fritz Burchart in *Die Schemata des Stationären Kreislauf bei Böhm-Bawerk und Marx*, *Weltwirtschaftliches Archiv*, 34. Bd., Heft a., S. 525 ff., 35. Bd., Heft I., S. 116 ff. and by Alfred Kähler in his work: *Die Theorie der Arbeiterfreisetzung durch Maschine*, 1933, S. 60-61.

production of the means of production, (d) that for the production of the means of consumption, the same amount of labour power as has been required for the production of the means of production is necessary, besides the means of production, and (e) that simple re-production takes places. (The assumption (c) corresponds with Böhm-Bawerk's first assumption referred to, and this, coupled with the assumption (e), are inherent in Böhm-Bawerk's way of thinking. The other assumption, namely, (a), (b) and (d), have no relation to the substance of the matter.) According to Böhm-Bawerk's concept, the period of production in such cases ought to be two years, therefore,  $s = \frac{3}{2}J$ . Then, how can we justify the formula:  $s = \frac{3}{2}J$ ? The answer to this question will make clear the peculiar assumptions which Böhm-Bawerk makes in his conception of the "period of production."

If it is assumed that both the means of production and the means of consumption are produced by independent producers and also that the interest-rate is 100 per-cent., then:

$$\text{I. } 100V_1 + 100M_1 = 200, \quad \text{II. } 200C_2 + 100V_2 + 300M_2 = 600.$$

But, if so,  $s = 100V_1 + 200C_2 + 100V_2 = 400$ , and  $J = 100V_1 + 100V_2 = 200$ , that is  $s \neq \frac{3}{2}J$ .

On the contrary, if it is assumed that there is no interest,

$$\text{I. } 100V_1 = 100, \quad \text{II. } 100C_2 + 100V_2 = 200.$$

And accordingly,  $s = 100V_1 + 100C_2 + 100V_2 = 300$ , and  $J = 100V_1 + 100V_2 = 200$ . That is,  $s = \frac{3}{2}J$ . In other words, the formula:  $s = \frac{3}{2}J$  is warrantable where there is no interest. But as Böhm-Bawerk deals with cases where there is interest, the above interpretation is not permissible.

The only other way of approach is to abandon the idea that the means of production are all produced by independent producers. It is to assume, in other words, that the means of production are all produced by the same producer, who produces the means of consumption with those means of

production. On this assumption and also on the assumption that the rate of interest is 100 per cent., we can conceive:

$$\text{I. } 100V_1=100, \quad \text{II. } 100C_2+100V_2+400M=600.$$

In this case, it is possible to contend that the capital invested in the production of the means of production remains of the same amount as it was when originally invested, even when it has become the means of production, though interest on capital becomes bigger because of the long period that intervenes before it become the means of consumption. Viewed in this light,  $s=100V_1+100C_2+100V_2=300$ , and  $J=100V_1+100V_2=200$ , and the formula:  $s=\frac{3}{2}J$ , becomes justified. In this case, it may be noted, there is no necessity of neglecting the interest. Thus, it can be made clear that Böhm-Bawerk assumes that the means of production are always produced by the same producer who produces the means of consumption with those means of production.

(In this respect, due note must be taken of the following fact: In reference to the above-mentioned case, whereas the interest-rate, if worked out by the general method of calculation, is:  $\{100V_1(1+i)+100V_2\}(1+i)=600 \therefore i=100\%$ , where the  $i$  means the rate of interest, it is, according to Böhm-Bawerk's method of calculation:  $i=400M \div (100V_1+100C_2+100V_2)=133.3333\%$ . This is because, under Böhm-Bawerk's method of calculation, the interest on the capital for the production of the means of production is to be calculated at simple interest. In so far as this rule is concerned, Böhm-Bawerk's method of calculation makes the method of production of a higher technical composition of capital appear more profitable than the method of production of a lower technical composition of capital.)

*Under such assumptions, constant capital ought to rise to the extent of a rise in wages, and consequently changes in wages cannot possibly be accompanied by changes in the price composition of capital, in so far as the same method of production concerns.*

One point deserves notice in this regard. If the price of the means of production is to rise or fall in strict accord with changes in wages, a comparatively profitable method of production under certain fixed wages ought to retain its comparative profitableness even when wages are changed, and the various methods of production whose degrees of profitableness are equal to one another under certain fixed wages, ought to retain this equality of profitableness under changed wages. For instance, suppose that for the production of a certain article three labourers are needed, when no means of production—the price of which and the wage of the labour are here assumed to be always equal—is employed, while two labourers will suffice, when one means of production is employed. Then, if real wage per labourer represents one-sixth of the product, the rate of profit is 100%, no matter which method of production may be employed, while, if real wage per labourer represents two-ninths of the product, it is 50%, whichever method of production may be used. So long as the price of the means of production rises or falls in strict accord with fluctuations in wages, therefore, a rise in wages cannot make the higher technical composition of capital become comparatively profitable. According to Böhm-Bawerk's theory, however, the method of production of a higher technical composition of capital, which was comparatively disadvantageous before a rise in wages, becomes advantageous by a rise in wages, notwithstanding the fact that it is assumed that the price of the means of production fluctuates in strict accord with wages. This is due entirely to the fact that his theory is formed on the basis of the assumptions that the means of production are all produced by the same producer who produces the means of consumption with those means of production and that the price of the means of production is equal to the amount of the capital invested for their production (and accordingly it does not include a profit). Because: That the changes in wages, under the ordinary organisation of production, cannot change the relative profitableness of the various methods of production with different technical composition of capital is because, under the ordinary organisation of production, the change of the price of the means of production, in strict harmony with wages, must presuppose changes in the production coefficient of the means of production; but just that necessity of the changes in the production coefficient is what falls away, in Böhm-Bawerk's system, because of his assumptions noted above.

*These assumptions are not apposite in practice, however.* If it is true in fact that the technical composition of capital is different according to the kinds of goods produced, it may be surely that the technical composition of capital of the means of production is higher than that of the means of consumption. It is also usual that the means of production are produced by independent producers.



*If the above-mentioned assumptions of Böhm-Bawerk are to be revised in such a way, and if, to that end, the logic shown in the revised tablar forms already given is to be followed, and if, further, it is to be supposed that the annual product per labourer is such as is given in the following table (there is no reason why the annual product per labourer should not be such), the total incomes of the working class will rather increase if wages are raised over and above where they will settle under free competition.*

Technical composition of capital	Annual product per labourer	Table No. 6 (Wages=520 fl.)			
		Annual profit per labourer	Number of employees	Annual profit per capital of 10,000 fl.	Labour income per capital of 10,000 fl.
9.7	678.2173 fl.	158.2173 fl.	6.7114093	1061.8611 fl.	3,489.9328 fl.
9.8	679.2987 „	159.2987 „	6.6666667	1061.9912 „	3,466.9667 „
9.9	680.3595 „	160.3595 „	6.6225166	1061.9835 „	3,443.7086 „
10.0	681.2963 „	161.2963 „	6.5789474	1061.1599 „	3,421.0526 „

Table No. 7 (Wages=530 fl.)			
Annual profit per labourer	Number of employees	Annual profit per capital of 10,000 fl.	Labour income per capital of 10,000 fl.
148.2173 fl.	6.6666667	988.1153 fl.	3,533.3333 fl.
149.2987 „	6.6225166	988.7331 „	3,509.9338 „
150.3595 „	6.5789474	989.2072 „	3,486.8421 „
151.2963 „	6.5359477	988.8647 „	3,464.0523 „

(The above table has been compiled on the assumption that the technical composition of capital regarding the means of production is equal to that of the means of consumption. If the circumstance is taken into consideration that the technical composition of capital of the means of production is higher than that of the means of consumption, the rate of unemployment resulting from a rise in wages

will become even lower, as can easily be understood in the light of the above-mentioned criticism of Böhm-Bawerk's theory, and consequently the possibility will be enhanced of the total incomes of labourers being increased by a movement of labourers for higher wages. Moreover, in case the technical composition of capital of the means of production is higher than that of the means of consumption, it is possible that the elevation of the technical composition of social capital as a result of higher wages will increase the total social income. Nor is it impossible that, when the average technical composition of capital of the means of production and the goods constituting real wages is higher than that of currency, higher wages may rather increase the number of employees.)

I have now demonstrated that Böhm-Bawerk's view-point that "the rise of wages over and above where they will settle under free competition will invariably reduce the incomes of the working class and that, therefore, a combination of labourers to secure higher wages cannot but produce the result opposite to what it intends to achieve" is based on an erroneous assumption regarding the technical composition of capital of products of various kinds and on a peculiar assumption in regard to the annual product of the labourer, and I have further shown that the removal of his peculiar assumptions makes his view-point concerning the "Machttheorie" untenable. But there remains another point to be indicated. In my dissertation I have so far assumed that the capitalist is in a position to act freely, as his capitalistic interest dictates, in dealing with the demand of his employees for higher wages. As a matter of fact, however, labourers (or the State) can exert their influence on capitalists and can influence counter-measures which capitalists may decide to adopt against the labourers' demand for higher wages. For instance, the State, by the exercise of national rights, and labourers, by dint of the right of participation in the management of business which they may acquire, can prevent the technical composition of capital being raised to a higher

level. So long as such things can happen, the basis of Böhm-Bawerk's contention will be further weakened.

## 5. OTHER CRITICISM OF BÖHM-BAWERK'S THEORY

Böhm-Bawerk's theory based on liberalism has been subjected to criticism from angles different from mine. Below, I shall examine Professor Takata's criticism.

Criticising Böhm-Bawerk's theory, Lindberg once said that :

"It is unthinkable that 10 per-cent. is the rate at which interest settles. Some of the industrial enterprisers are found to extend the period of their production to ten years and reduce wages to 300, in order to realise a profit of 26.66 per-cent. This will settle the marginal supply price for labour at 300. There is no reason why wages should settle at 500. The above example will be followed by other enterprisers and will result in the following: 10 years of round-about production, wages of 300 and the interest rate of 26.66%."<sup>1)</sup>

In his criticism of this theory of Lindberg and that of Böhm-Bawerk Professor Takata contends :

"In my own opinion, the equilibrium points of Böhm-Bawerk, Wicksell, Lindberg and Dorp cannot be regarded as real equilibrium points. In markets having the conditions mentioned by Böhm-Bawerk, neither wages nor interest can settle. In other words, no equilibrium is possible. New conditions must be added in order that an equilibrium may be formed. . . . (The equilibrium point of Böhm-Bawerk cannot be the real equilibrium point) . . . . If some of the enterprisers attempt to lower wages below 500, say to 300, nothing can prevent them from doing so. . . . In the transaction of enjoyable goods, marginal buyers cannot reduce demand prices at their own will, because buyers who have been excluded from the transaction, extramarginal buyers, will come forward and exclude marginal buyers. In the present case, however, there are no extramarginal buyers (since the quantity of capital is given and limited), and for this reason marginal buyers can reduce demand prices without incurring loss to themselves. . . . (Nor is Lindberg's equilibrium point the real one). . . . Does this mean, then, that in capital and labour markets the formation of natural rates of wages and interest is impossible? I do not think so. It (the reason why it seems impossible) is because of the lack of one indispensable condition which is always operating in actual markets so that equilibrium rates are always formed, though only approximately—this condition being the relation of social powers."<sup>2)</sup>

1) Jak. Kr. Lindberg; Die Kapitalzinstheorie, Zeitschrift für Nationalökonomie, Bd. IV. Heft 4. S. 505 ff. (Yasuma Takata: A critical analysis of Böhm-Bawerk's theory of capital, Kyoto University Economic Review, July 1934, p. 104.)

2) Takata; *ibid.* pp. 105-108.

The Professor, as well as Lindberg, it will be noted, leaves uncontroverted the errors in Böhm-Bawerk's theory which I have pointed out, but let this point be passed over here. It is his criticism of Böhm-Bawerk's theory on which at present I wish to comment. He bases his criticism solely on the ground that there are "no extramarginal buyers." This argument is untenable, however, for if some capitalists lower wages below 500 gulden, other capitalists will deem production for a shorter period than six years more profitable, with the result that these capitalists will need more labour power. For this reason, they will figure as extramarginal buyers.

The Professor, in enunciating his point of view, links it with Wicksell's theory. (As can easily be inferred from Böhm-Bawerk's theory, if intervals of supplementary investments are infinitely small,  $s = \frac{n}{2}J$ . Now, let productive resources per labourer be  $s'$ , wages  $L$ , and the number of Labourer  $A$ , that is to say,  $\frac{S}{A} = s'$ , and  $\frac{J}{A} = L$ . Then, the equation,  $s' = \frac{n}{2}L$ , can be obtained from the equation  $s = \frac{n}{2}J$ . If the interest-rate is  $z$ , the total product per labourer will be  $s'(1+z)$ . Next, let the annual product per labourer be  $P$ . As already stated, it represents means of consumption, and accordingly it embodies the total product of a labourer minus the means of production. And the total price of the means of production per labourer is equal to the quantity that remains after the annual wages,  $L$ , have been deducted from  $s'$ , or  $\frac{n}{2}L$ . The annual product of a labourer, that is,  $P$ , is, therefore,  $P = s'(1+z) - (\frac{n}{2} - 1)L = \frac{n}{2}L(1+z) - (\frac{n}{2} - 1)L = L(1 + \frac{zn}{2})$  . . . the equation (a). Wicksell's theory, which Professor Takata cites in his article, is developed with this equation (a) as its starting point. Starting from the equation (a), Wicksell makes the following assertion :

"P is the known function of n. (Therefore, the equation (b):  $P=F(n)$ , can be obtained.) Let Z be a known number, and then it becomes necessary to determine n so as to make L of the maximum size. This can be attained in the following way: Differentiate both sides of the equation (a) in respect of n. As  $dL=0$  in case L represents the maximum, L is treated as a fixed number. The equation (c):  $\frac{dP}{dn} = \frac{L \cdot Z}{2}$  is consequently obtained. From both this equation and the equation (a) . . . . the value of n and L (as expressed by Z) can be obtained. . . . Let me next consider the contrary case. Let it be supposed that wages are given and a capitalist, as entrepreneur, carries on his production work with the object of deriving the maximum profit from the total capital invested in production. . . . In this case, L is a known number, and the question is how to determine n so as to make Z the maximum. In this case also, differentiation in regard to n is carried out in the same way as when both L and Z are constants, and consequently the equation,  $\frac{dP}{dn} = \frac{L \cdot Z}{2}$  is obtainable, as in the former case. From this equation, the values of n and Z (as expressed by L) are next sought. . . . Where the total amount of capital and the number of employees are fixed unalterably in the section of production concerned, not only can the above-mentioned relationships be established between wages, interest-rate and the period of production . . . , but it is even possible to find their size. As  $S'$ , representing the capital invested in a labourer, is . . . .  $\frac{n \cdot L}{2}$ , (since  $S' \cdot A = \frac{A \cdot n \cdot L}{2}$ , and  $S'A=S$  too) the equation (d),  $S = \frac{A \cdot n \cdot L}{2}$ , can be obtained. From the equation (a), (b), (c) and (d), the values of P, L, n, and Z (as expressed by S and A) can be obtained."<sup>1)</sup>

Wicksell's formulae are neither more nor less than a mathematical expression of Böhm-Bawerk's theory, and consequently they contain the very errors contained in Böhm-Bawerk's theory (errors which I have pointed out in the present study). But Professor Takata's criticism does not refer to this point. He makes the following observation in regard to Wicksell's formulae:

"How can an equilibrium (Wicksell's) be formed in this case? . . . It is because equation (3) is presupposed. But in equation (3) L (representing wages) is presupposed. . . . (But) under the conditions given by Böhm-Bawerk, entrepreneurs are not in a position to accept wages as fixed rates. Rather the enterprisers are placed in a position of changing L while changing n at the same time correspondingly. For this reason, equation (3) is

1) Knut Wicksell: *Über Wert, Kapital und Rente, nach den neueren nationalökonomischen Theorien*, 1893. S. 96-101.

2) Yasuma Takata: *ibid.* pp. 112-113.

impossible of formation. How, then, is an equilibrium established in actual economy? In my opinion, there should be a power equation— $L=f(n, P)$ —showing that supply wages (or labour supply functions) are essentially determined by the relation of social powers. . . . But then we shall have a less number of unknown quantities than equations. But if  $K$  representing the amount of capital be taken as an unknown quantity, the two will become equal in number."<sup>2)</sup>

Here, the Professor bases his criticism of Wicksell's equations on the ground that "Capitalists are not in a position to accept wages as fixed rates." But are not individual capitalists, as parties to free competition, placed in a position to treat wages as fixed? The Professor says:

"Limiting our consideration to this one branch only, we can say that an enterpriser will have to raise wages as high as possible, if he hopes to retain his labourers against the attempts of enterprisers in other branches of industry to get his labourers away from him. Thus, it is impossible for enterprisers to reduce wages arbitrarily, say from 500 to 300. In other words, individual buyers of labour are unable to control the price of labour by themselves, but the situation is entirely different when the industry of society as a whole is considered, for in this case labour can be transacted at a reduced price."<sup>1)</sup>

The Professor takes the view that to consider the case of one branch of industry is one thing and to consider the the case of industry of society as a whole is another. But what is meant by considering industry as a whole? We assume here a large number of entrepreneurs who are in competition with one another, and so long as this assumption stands, the idea of "considering industry as a whole" cannot mean to regard the entire industry as under the control of a single entrepreneur. It is, then, difficult to understand what the phrase really means.

There is another point in the Professor's theory which is open to controversy and which lies in the so-called power equation. He says that the amount of capital can be taken as an unknown quantity by way of remedying the excess of equations caused by the inclusion of the power equation. But it must be remembered that the amount of capital is by no means determined by such circumstances only as are

1) *ibid.* p. 114.

shown in the Professor's equations. It carries its own determining circumstances. If, therefore, the amount of capital is to be taken as an unknown quantity, the capital supply function equation must necessarily come in instead. Consequently, the excess of equations caused by the inclusion of the so-called power equation cannot be remedied by treating the amount of capital as an unknown quantity.

KEI SHIBATA